Performance Characteristic Sheet

EFFECTIVE DATE: November 27, 1995 EDITION NO.: 3

MANUFACTURER AND MODEL:

Make: *Radiation Monitoring Devices*
Model: *LPA-1*
Source: ^{57}Co
Note: This sheet supersedes all previous sheets for the XRF instrument of the make, model, and source shown above.

FIELD OPERATION GUIDANCE

OPERATING PARAMETERS

Quick mode, nominal 20-second standard mode, or nominal 30-second standard mode.

XRF CALIBRATION CHECK LIMITS

Instruments sold prior to June 26, 1995, that have not been serviced since June 26, 1995
0.7 to 1.1 mg/cm^2 (inclusive)

Instruments sold or serviced after June 26, 1995
0.7 to 1.3 mg/cm^2 (inclusive)

SUBSTRATE CORRECTION:

For XRF results below 4.0 mg/cm^2, using instruments sold prior to June 26, 1995, that have not been serviced since June 26, 1995, substrate is correction recommended for:

Metal and wood using quick mode or either 20-second or 30-second standard mode readings.

For XRF results below 4.0 mg/cm^2, using instruments sold or serviced after June 26, 1995, substrate is correction recommended for:

Metal using 30-second standard mode readings.
None using quick mode readings.

Substrate correction is not recommended for:

Instruments sold prior to June 26, 1995 that have not been serviced since June 26, 1995:

- Brick, Concrete, Drywall, and Plaster using quick mode or either 20-second or 30-second standard mode readings

For those instruments sold or serviced after June 26, 1995 :

- Brick, Concrete, Drywall, Plaster, and Wood using 30-second standard mode readings
- Brick, Concrete, Drywall, Metal, Plaster, and Wood using quick mode readings

INCONCLUSIVE RANGE OR THRESHOLD

For those instruments sold prior to June 26, 1995, that have not been serviced since June 26, 1995 :

30-SECOND STANDARD MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD (mg/cm^2)
Results corrected for substrate bias on metal and wood substrates only	Brick Concrete Drywall Metal Plaster Wood	0.8 0.8 0.7 0.8 0.8 0.9

For those instruments sold prior to June 26, 1995, that have not been serviced since June 26, 1995 :

20-SECOND STANDARD MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD (mg/cm^2)
Results corrected for substrate bias on metal and wood substrates only	Brick Concrete Drywall Metal Plaster Wood	0.7 0.7 0.7 0.9 0.8 0.8

For those instruments sold prior to June 26, 1995, that have not been serviced since June 26, 1995 :

QUICK MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD (mg/cm^2)	INCONCLUSIVE RANGE (mg/cm^2)
Results corrected for substrate bias on metal and wood substrates only	Brick Concrete Drywall Metal Plaster Wood	0.8 0.8 None 1.0 0.8 0.8	None None 0.7* None None None

*This instrument displays tenths of a mg/cm^2. The only value displayed that represents an inconclusive reading is 0.7 mg/cm^2.

For those instruments sold or serviced after June 26, 1995:

30-SECOND STANDARD MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD (mg/cm^2)
Results corrected for substrate bias on metal substrate only	Brick Concrete Drywall Metal Plaster Wood	1.0 1.0 1.0 0.9 1.0 1.0

For those instruments sold or serviced after June 26, 1995:

QUICK MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD (mg/cm^2)	INCONCLUSIVE RANGE (mg/cm^2)
Readings not corrected for substrate bias on any substrate	Brick Concrete Drywall Metal Plaster Wood	1.0 1.0 1.0 None 1.0 1.0	None None None 1.0 to 1.2 None None

BACKGROUND INFORMATION

EVALUATION DATA SOURCE AND DATE

This sheet is supplemental information to be used in conjunction with Chapter 7 of the HUD *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing* ("HUD Guidelines"). Performance parameters shown on this sheet are calculated from the EPA/HUD evaluation using archived building components. Testing was conducted on approximately 150 test locations. All of the test locations were tested three times, once in March 1995, once in July 1995, and once in September 1995 using three distinct instruments. The instrument that performed testing in March had a new source installed in January 1995 with 12 mCi initial strength. The instrument that performed testing in July had a new source installed in June 1995 with 12 mCi initial strength. The instrument that performed testing in September had a new source installed in February 1995 with 12 mCi initial strength. LPA-1 instruments that were purchased before June 26, 1995 and have not been serviced since June 26, 1995 have a different version of firmware than those instruments sold or serviced after June 26, 1995. Therefore, this sheet distinguishes between instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995 from those instruments serviced or sold after this date.

OPERATING PARAMETERS

Performance parameters shown in this sheet are applicable only when properly operating the instrument using the manufacturer's instructions and procedures described in Chapter 7 of the HUD Guidelines.

XRF CALIBRATION CHECK:

The calibration of the XRF instrument should be checked using the paint film nearest 1.0 mg/cm^2 in the NIST Standard Reference Material (SRM) used (e.g., for NIST SRM 2579, use the 1.02 mg/cm^2 film).

If readings are outside the acceptable calibration check range, follow the manufacturer's instructions to bring the instruments into control before XRF testing proceeds

SUBSTRATE CORRECTION VALUE COMPUTATION

Chapter 7 of the HUD Guidelines provides guidance on correcting XRF results for substrate bias. Supplemental guidance for using the paint film nearest 1.0 mg/cm^2 for substrate correction is provided:

XRF results are corrected for substrate bias by subtracting from each XRF result a correction value determined separately in each house for single-family housing or in each development for multifamily housing, for each substrate. The correction value is an average of XRF readings taken over the NIST SRM paint film nearest to 1.0 mg/cm^2 at test locations that have been scraped bare of their paint covering. Compute the correction values as follows:

- Using the same XRF instrument, take three readings on a bare substrate area covered with the NIST SRM paint film nearest 1 mg/cm^2. Repeat this procedure by taking three more readings on a second bare substrate area of the same substrate covered with the NIST SRM.

- Compute the correction value for each substrate type where XRF readings indicate substrate correction is needed by computing the average of all six readings as shown below.

  For each substrate type (the 1.02 mg/cm^2 NIST SRM is shown in this example; use the actual lead loading of the NIST SRM used for substrate correction):

$$\left.\begin{matrix}\textit{Correction}\\ \textit{Value}\end{matrix}\right\} = \frac{1^{st} + 2^{nd} + 3^{rd} + 4^{th} + 5^{th} + 6^{th}\ \textit{Reading}}{6} - 1.02 mg/cm^2$$

- Repeat this procedure for each substrate requiring substrate correction in the house or housing development.

EVALUATING THE QUALITY OF XRF TESTING

Randomly select ten testing combinations for retesting from each house or from two randomly selected units in multifamily housing. Use either 15-second readings or 60-second readings.

Conduct XRF retesting at the ten testing combinations selected for retesting.

Determine if the XRF testing in the units or house passed or failed the test by applying the steps below.

Compute the Retest Tolerance Limit by the following steps:

Determine XRF results for the original and retest XRF readings. Do not correct the original or retest results for substrate bias. In single-family and multi-family housing, a result is defined as a single reading. Therefore, there will be ten original and ten retest XRF results for each house or for the two selected units.

Calculate the average of the original XRF result and retest XRF result for each testing combination.

Square the average for each testing combination.

Add the ten squared averages together. Call this quantity C.

Multiply the number C by 0.0072. Call this quantity D.

Add the number 0.032 to D. Call this quantity E.

Take the square root of E. Call this quantity F.

Multiply F by 1.645. The result is the Retest Tolerance Limit.

Compute the average of all ten original XRF results.

Compute the average of all ten retest XRF results.

Find the absolute difference of the two averages.

If the difference is less than the Retest Tolerance Limit, the inspection has passed the retest. If the difference of the overall averages equals or exceeds the Retest Tolerance Limit, this procedure should be repeated with ten new testing combinations. If the difference of the overall averages is equal to or greater than the Retest Tolerance Limit a second time, then the inspection should be considered deficient.

Use of this procedure is estimated to produce a spurious result approximately 1% of the time. That is, results of this procedure will call for further examination when no examination is warranted in approximately 1 out of 100 dwelling units tested.

BIAS AND PRECISION

Do not use these bias and precision data to correct for substrate bias. These bias and precision data were computed without substrate correction from samples with reported laboratory results less than 4.0 mg/cm^2 lead. The data which were used to determine the bias and precision estimates given in the three tables above have the following properties. During the March 1995 testing, there were 11 test locations with a laboratory reported result equal to or greater than 4.0 mg/cm^2 lead. Of these, one 20-second standard mode reading was less than 1.0 mg/cm^2 and none of the quick mode readings were less than 1.0 mg/cm^2. During the July testing, there were 15 test locations with a laboratory reported result equal to or greater than 4.0 mg/cm^2 lead. Of these, one 30-second standard mode reading was less than 1.0 mg/cm^2 and none of the quick mode readings were less than 1.0 mg/cm^2. During the September 1995testing, there were 15 test locations with a laboratory reported result equal to or greater than 4.0 mg/cm^2 lead. Of these, two 20-second and one 30-second standard mode readings were less than 1.0 mg/cm^2, and one quick mode reading was less than 1.0 mg/cm^2. The two instruments that tested in March and September are representative of instruments sold prior to June 26, 1995, and have not been serviced since June 26, 1995, and the instrument that tested in July is representative of instruments sold or serviced after June 26, 1995. These data are for illustrative purposes only. Actual bias must be determined on the site. Inconclusive ranges provided above already account for bias and precision. Bias and precision ranges are provided to show the variability that was found between machines of the same model.

For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995 :

20-SECOND READING MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	BIAS RANGE[P] (mg/cm^2)	PRECISION[*] (mg/cm^2)	PRECISION RANGE[P] (mg/cm^2)
0.0 mg/cm^2	Brick	-0.2	(-0.1,-0.2)	0.2	(0.1, 0.2)
	Concrete	-0.2	(-0.1,-0.2)	0.2	(0.1, 0.2)
	Drywall	-0.2	(-0.2,-0.3)	0.2	(0.1, 0.2)
	Metal	-0.4	(-0.4,-0.5)	0.2	(0.1, 0.2)
	Plaster	-0.1	(-0.1,-0.1)	0.2	(0.1, 0.2)
	Wood	-0.2	(-0.1,-0.2)	0.2	(0.1, 0.2)
0.5 mg/cm^2	Brick	-0.2	(-0.2,-0.3)	0.3	(0.2, 0.3)
	Concrete	-0.2	(-0.2,-0.3)	0.3	(0.2, 0.3)
	Drywall	-0.3	(-0.2,-0.3)	0.3	(0.2, 0.3)
	Metal	-0.5	(-0.4,-0.6)	0.3	(0.2, 0.3)
	Plaster	-0.2	(-0.2,-0.2)	0.3	(0.2, 0.3)
	Wood	-0.2	(-0.2,-0.3)	0.3	(0.2, 0.3)
1.0 mg/cm^2	Brick	-0.3	(-0.2,-0.4)	0.3	(0.3, 0.4)
	Concrete	-0.3	(-0.2,-0.4)	0.3	(0.3, 0.4)
	Drywall	-0.3	(-0.3,-0.4)	0.3	(0.3, 0.4)
	Metal	-0.6	(-0.5,-0.6)	0.3	(0.3, 0.4)
	Plaster	-0.2	(-0.2,-0.2)	0.3	(0.3, 0.4)
	Wood	-0.3	(-0.2,-0.4)	0.3	(0.3, 0.4)
2.0 mg/cm^2	Brick	-0.4	(-0.3,-0.5)	0.5	(0.4, 0.5)
	Concrete	-0.4	(-0.3,-0.5)	0.5	(0.4, 0.5)
	Drywall	-0.5	(-0.4,-0.6)	0.5	(0.4, 0.5)
	Metal	-0.7	(-0.6,-0.7)	0.5	(0.4, 0.5)
	Plaster	-0.3	(-0.3,-0.4)	0.5	(0.4, 0.5)
	Wood	-0.4	(-0.3,-0.5)	0.5	(0.4, 0.5)

[P]Ranges are provided to show the variability between machines of the same model.
[*]Precision at 1 standard deviation.

For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995 :

30-SECOND READING MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	PRECISION* (mg/cm^2)
0.0 mg/cm^2	Brick	-0.1	0.1
	Concrete	-0.1	0.1
	Drywall	-0.2	0.1
	Metal	-0.4	0.1
	Plaster	-0.1	0.1
	Wood	-0.1	0.1
0.5 mg/cm^2	Brick	-0.2	0.2
	Concrete	-0.2	0.2
	Drywall	-0.3	0.2
	Metal	-0.5	0.2
	Plaster	-0.1	0.2
	Wood	-0.2	0.2
1.0 mg/cm^2	Brick	-0.2	0.3
	Concrete	-0.2	0.3
	Drywall	-0.3	0.3
	Metal	-0.6	0.3
	Plaster	-0.2	0.3
	Wood	-0.2	0.3
2.0 mg/cm^2	Brick	-0.4	0.4
	Concrete	-0.4	0.4
	Drywall	-0.5	0.4
	Metal	-0.7	0.4
	Plaster	-0.3	0.4
	Wood	-0.4	0.4

*Precision at 1 standard deviation.

For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995 :

QUICK MODE MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	BIAS RANGE[P] (mg/cm^2)	PRECISION[*] (mg/cm^2)	PRECISION RANGE[P] (mg/cm^2)
0.0 mg/cm^2	Brick	-0.2	(-0.2,-0.3)	0.3	(0.3, 0.3)
	Concrete	-0.2	(-0.2,-0.3)	0.3	(0.3, 0.3)
	Drywall	-0.3	(-0.2,-0.3)	0.3	(0.3, 0.3)
	Metal	-0.6	(-0.6,-0.7)	0.3	(0.3, 0.3)
	Plaster	-0.2	(-0.2,-0.2)	0.3	(0.3, 0.3)
	Wood	-0.2	(-0.2,-0.3)	0.3	(0.3, 0.3)
0.5 mg/cm^2	Brick	-0.3	(-0.2,-0.3)	0.4	(0.3, 0.4)
	Concrete	-0.3	(-0.2,-0.3)	0.4	(0.3, 0.4)
	Drywall	-0.3	(-0.3,-0.4)	0.4	(0.3, 0.4)
	Metal	-0.7	(-0.6,-0.8)	0.4	(0.3, 0.4)
	Plaster	-0.2	(-0.2,-0.2)	0.4	(0.3, 0.4)
	Wood	-0.3	(-0.2,-0.3)	0.4	(0.3, 0.4)
1.0 mg/cm^2	Brick	-0.3	(-0.3,-0.4)	0.4	(0.4, 0.5)
	Concrete	-0.3	(-0.3,-0.4)	0.4	(0.4, 0.5)
	Drywall	-0.4	(-0.3,-0.4)	0.4	(0.4, 0.5)
	Metal	-0.7	(-0.7,-0.8)	0.4	(0.4, 0.5)
	Plaster	-0.3	(-0.3,-0.3)	0.4	(0.4, 0.5)
	Wood	-0.3	(-0.3,-0.4)	0.4	(0.4, 0.5)
2.0 mg/cm^2	Brick	-0.4	(-0.4,-0.5)	0.5	(0.4, 0.6)
	Concrete	-0.4	(-0.4,-0.5)	0.5	(0.4, 0.6)
	Drywall	-0.5	(-0.4,-0.6)	0.5	(0.4, 0.6)
	Metal	-0.8	(-0.7,-1.0)	0.5	(0.4, 0.6)
	Plaster	-0.4	(-0.4,-0.4)	0.5	(0.4, 0.6)
	Wood	-0.4	(-0.4,-0.5)	0.5	(0.4, 0.6)

[P]Ranges are provided to show the variability between machines of the same model.
[*]Precision at 1 standard deviation.

For those instruments sold or serviced after June 26, 1995

30-SECOND STANDARD MODE READING MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	PRECISION* (mg/cm^2)
0.0 mg/cm^2	Brick	0.0	0.1
	Concrete	0.0	0.1
	Drywall	0.1	0.1
	Metal	0.3	0.1
	Plaster	0.1	0.1
	Wood	0.0	0.1
0.5 mg/cm^2	Brick	0.0	0.2
	Concrete	0.0	0.2
	Drywall	0.0	0.2
	Metal	0.2	0.2
	Plaster	0.0	0.2
	Wood	0.0	0.2
1.0 mg/cm^2	Brick	0.0	0.3
	Concrete	0.0	0.3
	Drywall	0.0	0.3
	Metal	0.2	0.3
	Plaster	0.0	0.3
	Wood	0.0	0.3
2.0 mg/cm^2	Brick	-0.1	0.4
	Concrete	-0.1	0.4
	Drywall	-0.1	0.4
	Metal	0.1	0.4
	Plaster	-0.1	0.4
	Wood	-0.1	0.4

*Precision at 1 standard deviation.

For those instruments sold or serviced after June 26, 1995:

QUICK MODE READING MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	PRECISION* (mg/cm^2)
0.0 mg/cm^2	Brick	0.0	0.2
	Concrete	0.0	0.2
	Drywall	0.0	0.2
	Metal	0.2	0.2
	Plaster	0.0	0.2
	Wood	0.0	0.2
0.5 mg/cm^2	Brick	0.0	0.3
	Concrete	0.0	0.3
	Drywall	0.0	0.3
	Metal	0.2	0.3
	Plaster	0.0	0.3
	Wood	0.0	0.3
1.0 mg/cm^2	Brick	0.0	0.4
	Concrete	0.0	0.4
	Drywall	0.0	0.4
	Metal	0.1	0.4
	Plaster	-0.1	0.4
	Wood	0.0	0.4
2.0 mg/cm^2	Brick	-0.1	0.5
	Concrete	-0.1	0.5
	Drywall	-0.1	0.5
	Metal	0.1	0.5
	Plaster	-0.1	0.5
	Wood	-0.1	0.5

*Precision at 1 standard deviation.

CLASSIFICATION OF RESULTS

XRF results are classified as positive if they are greater than the upper boundary of the inconclusive range, and negative if they are less than the lower boundary of the inconclusive range, or inconclusive if in between. The inconclusive range includes both its upper and lower bounds. Earlier editions of this *XRF Performance Characteristics Sheet* did not include both bounds of the inconclusive range as "inconclusive." While this edition of the Performance Characteristics Sheet uses a different system, the specific XRF readings that are considered positive, negative, or inconclusive for a given XRF model and substrate remain unchanged, so previous inspection results are not affected.

DOCUMENTATION:

A document titled *Methodology for XRF Performance Characteristic Sheets* provides an explanation of the statistical methodology used to construct the data in the sheets, and provides empirical results from using the recommended inconclusive ranges or thresholds for specific XRF instruments. For a copy of this document call the National Lead Information Center Clearinghouse at 1-800-424-LEAD.

This XRF Performance Characteristics Sheet is a joint product of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Housing and Urban Development (HUD). The issuance of this sheet does not constitute rulemaking. The information provided here is intended solely as guidance to be used in conjunction with Chapter 7, Lead-Based Paint Inspection, of the *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*. EPA and HUD reserve the right to revise this guidance. Please address questions and comments on this sheet to: Director, Office of Lead Hazard Control (L), U.S. Department of Housing and Urban Development, 451 Seventh St, S.W., Washington, DC 20410.